# MODEL 3558

## MANUAL RESPONDER UNIT (MRU)

(Also Emery 58)

Northeast Electronics Instruction Manual
A3558-00-600 Issue 3 May 1984

northeast electronics
DIVISION OF tau-tron inc.
A UNIT OF GENERAL SIGNAL

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# MANUAL RESPONDER UNIT

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## 1. GENERAL

### A. Scope of Manual

**1.01** This manual describes the features of the Model 3558 Manual Responder Unit (MRU) and its use. Table A is a list of abbreviations and acronyms used in this manual.

**1.02** This section is being reissued to add detailed information on testing procedures. Additional descriptive and application information on test lines and responders has also been included.

### B. Applications

**1.03** The Model 3558 MRU provides a portable means of direct manual control and interrogation of several standard test lines and responders. The unit produces command signaling to set up the required testing routines. A data receiver decodes test results which are exhibited on an LED display.

**1.04** The MRU is capable of performing cooperative two-way testing with the following equipment:

- Northeast Electronics Model TTS 1050 Series Test Lines and Responders
- WECO Model 51B Responder (or equivalent)
- WECO Model 52A Responder (or equivalent)
- WECO Model 56A Mini-Responder (or equivalent)
- APC 1051B Test Line/Responder
- AECO 105 Responder
- APC 1056A Mini-Responder

**1.05** The MRU is capable of performing one-way testing with the following equipment:

- Northeast Electronics Model 3558 MRU
- Code 100 Test Line
- Code 102 Test Line
- Code 104 Test Line
- Code 107 Test Line

### C. Specifications

**1.06** Specifications of the Model 3558 MRU are given in Table B.

## TABLE A

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ABS | Acrylonitrile Butayadine Styrene (Plastic) |
| ACD | Automatic call distributor |
| ALL | Step through codes 01 through 06 |
| ASCII | American Standard Code for Information Interchange |
| cps | Characters per second |
| dB | Decibel |
| dBm | Ratio of power referenced to 1 milliwatt at 1000 Hz into a known impedance, measured in dB |
| dBm0 | Ratio of power in dB referenced to some fixed TLP |
| dBrnC | Power in dB above a reference noise of – 90 dBm with "C" message weighting |
| DP | Dial pulse |
| ERL | Echo return loss |
| F → N | Far to near |
| FSK | Frequency shift keying |
| GS 0.4 | Gain slope at 404 Hz, – 16 dBm0 |
| GS 1.0 | Gain slope at 1004 Hz, – 16 dBm0 |
| GS 2.8 | Gain slope at 2804 Hz, – 16 dBm0 |
| ICT | Idle circuit termination |
| IPM | Interruptions per minute |
| LED | Light emitting diode |
| LOSS | Loss measured at 1004 Hz at 0 dBm0 |
| MF | Multifrequency signaling (CCITT #5 compatible) |
| MRU | Manual Responder Unit |
| N → F | Near to far |
| NOISE | C-message (weighted) noise. Measurement of unwanted signals over a broad spectrum, measured in dBrnC |
| N/T | Noise with tone (C-notch) measurement |
| PAR | Peak to average ratio |
| PBX | Private branch exchange |
| ROTL | Remote office test line |
| SCK | Self-check |
| SRH | Singing return loss, high |
| SRL | Singing return loss, low |

## TABLE A (Cont)

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| MEAS/SCK | Measure/self-check |
| TLP | Transmission level point |
| TPT | Test progress tone 2225 Hz |
| TT | Touch Tone® (DTMF) signaling |
| TUT | Trunk under test |

## TABLE B

## SPECIFICATIONS

| | |
|---|---|
| **Measuring Circuits** | |
| Loss measurements | + 1.9 to − 15.7 dBm ± 0.1 dB ± 1 count |
| Gain slope measurements | − 14.1 to − 36.7 dBm ± 0.1 dB @ 1 kHz ± 1 count |
| | − 14.1 to − 36.7 dBm ± 0.3 dB @ 400 Hz and 2800 Hz (± .1 dB typically) ± 1 count |
| C-message noise measurement | 16 to 54 dBrnC ± 1.0 dB ± 1 count |
| C-notch noise measurement | 35 to 73 dBrnC ± 1.0 dB ± 1 count |
| Type of detection | True RMS |
| Longitudinal balance | Per Bell Pub. 41009 |
| **Tone Generator Circuits** | |
| Test tones | 404, 1004, 2804 Hz − 0/+ 4 Hz |
| Transmit levels | 0, − 2, − 16, − 18 dBm ± 0.1 dB |
| Harmonic distortion plus noise | > 50 dB below fundamental (per Bell Pub. 41009) |
| Source and load impedance | 600 or 900 Ω with 30 dB return loss (per Bell Pub. 41009) |
| Terminal balance impedance | 600 or 900 Ω in series with 2.16 mf ± 1 % |
| **Circuit (Trunk) Signaling** | |
| Access number register | 15 digits |
| Dial pulse speed | 10 ± 1 pps, 63 % ± 4 % BRK, 0.85 ± 0.05 second interdigit timing |
| DTMF speed and output level | 7.3 pps, 50 % duty, − 7 dB ± 1.0 dB per tone |
| MF speed and output level | 6.2 digits per second, 50 % duty, − 7 dB ± 1.0 dB per tone |
| Solid state hold circuit | ≥ 20 ma. loop current with 1700 Ω loop R and 48 V |

**TABLE B (Cont)**

**SPECIFICATIONS**

| | |
|---|---|
| **FSK Receiver** | |
| Guard tone | 1200 Hz ± 20 Hz |
| Data tone | 2225 Hz ± 50 Hz |
| Dynamic range | − 3 dBm to − 28 dBm ± 1 dB |
| **Optional Printer Interface** | |
| Type | RS-232C |
| Character format | ASCII |
| Character rate | 30 cps |
| Baud rate | 300 baud |
| **Electrical** | |
| Input power | 115 V ac ± 10 %; 12 W nominal |
| Fuse | 2 A, AGC |
| **Environmental** | |
| Temperature range | 32 to 122 °F, 0 to 50 °C |
| Humidity | Up to 95 %, noncondensing |
| **Mechanical** | |
| Dimensions (H × W × D) (less mounting adaptors) | 7.5 × 8.5 × 9.25 inches; 19.1 × 21.6 × 23.5 centimeters |
| Weight | 8.5 pounds; 3.9 kilograms |
| Mounting | Standard 19- or 23-inch rack with appropriate adaptors |
| Circuit access | 310-type jack or 5-way binding posts |
| Controls | 12-key keypad, clear, send, pause, cursor control, mode select, hook switch, loop start/ground start, on/off and monitor volume, measure test/self-check |
| Displays and indicators | 15 LED digits (0.3 inches high), power lamp, answer supervision lamp |

## 2. DESCRIPTION

### A. Physical Description

**2.01** The Model 3558 MRU is a portable instrument weighing approximately 8.5 pounds (3.9 kg) and measuring 7.5 inches (19.1 cm) high, 8.5 inches (21.6 cm) wide, and 9.25 inches (23.5 cm) deep. The housing is fabricated of high-impact ABS material and aluminum. A locking handle is designed to also serve as a tilt stand. The handle is positioned and tightened in the selected position with two pivot-point screw caps.

### B. Front Panel

**2.02** The MRU front panel controls, indicators, and connectors are shown in Figure 1.

### 2.03 Display

**2.04** The display is a 15-digit, 7-segment per digit LED display with a 0.3-inch character height. Fifth and tenth digit markers are located on the display filter for separation of test codes and measurement displays. The display is used in three modes which are described in Table C.

### 2.05 Controls and Indicators

**2.06** MRU controls and indicators are described in Table D.

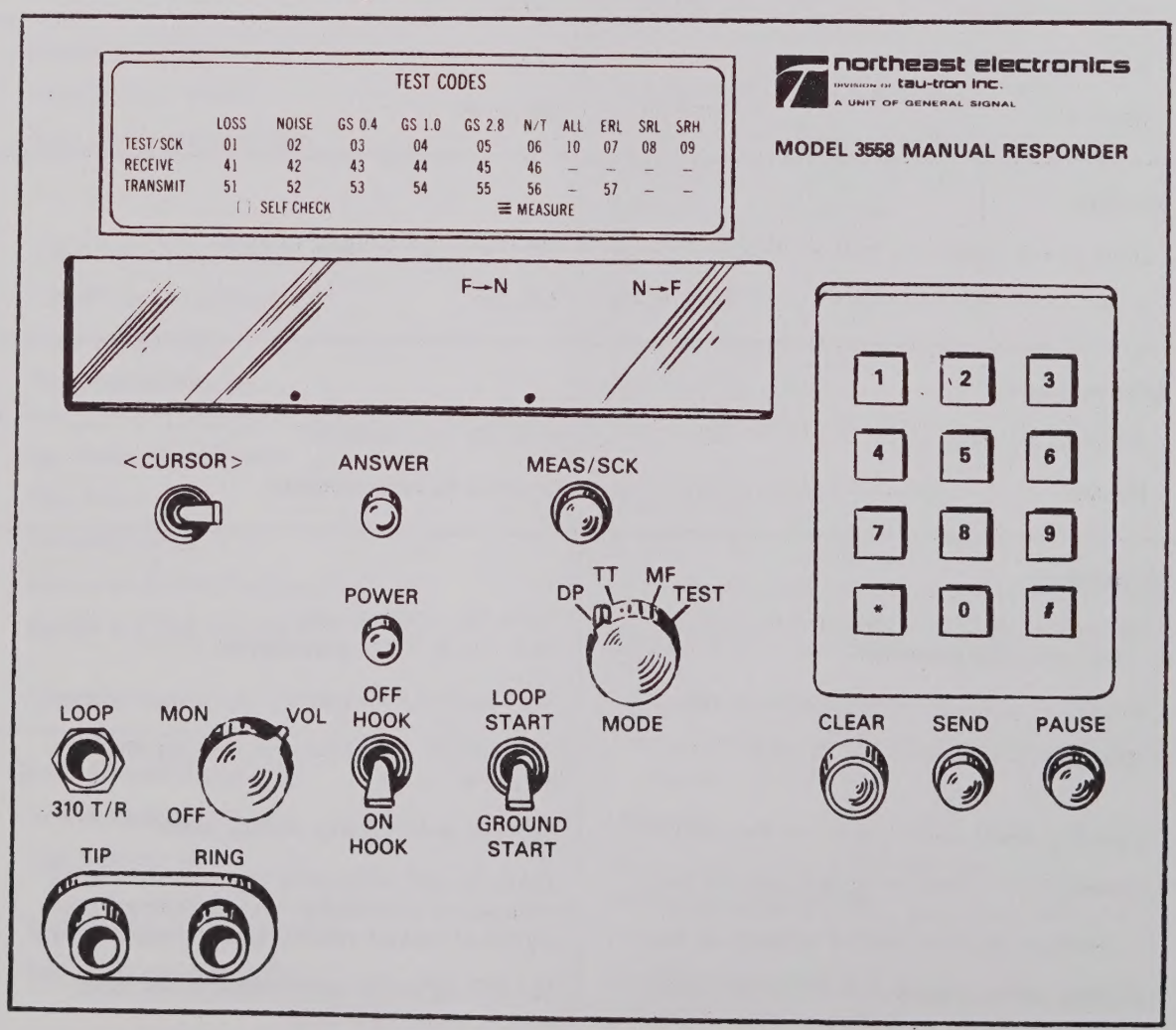


**Fig. 1—Front Panel**

## TABLE C

## DISPLAY MODES

| MODE | DESCRIPTION |
|---|---|
| POWER ON SELF-TEST | When the instrument is initially powered up, a routine check of the microprocessor circuitry within the instrument is performed. Satisfactory completion of this step results in a "PASS" indication on the first four digit locations of the display field. (For ease of character reference, the display field digits are numbered one through fifteen from left to right.) "PASS" displays for five seconds and is then automatically extinguished. At this point the instrument is ready to use. |
| ACCESS NUMBER | The far-end access number entered into the memory of the MRU is displayed for verification and editing. Pauses in the outpulsing sequence are indicated by a dash (-) on the display. |
| TEST | One-digit impedance and TLP codes appear in display locations 1 and 2 respectively. A self-check (□) or measure (≡) symbol appears in display location 3. A two-digit test code is displayed in locations 4 and 5.<br><br>The near-end measurement is displayed in digit loctions 8, 9, and 10 under the "F → N" label on the display filter. Negative values of near-end measurement are preceded by a minus (−) sign in digit location 7; positive measurement readings are unsigned.<br><br>The far-end data is displayed in digit locations 13, 14, and 15 under the "N → F" label on the display filter. Negative values are preceded by a minus sign in digit location 12.<br><br>Digit locations 6 and 11 are blank during testing. |

## TABLE D

## CONTROLS AND INDICATORS

| CONTROL OR INDICATOR | DESCRIPTION |
|---|---|
| OFF HOOK/ON HOOK toggle switch | The OFF HOOK/ON HOOK is a two-position toggle switch. When in the OFF HOOK position the MRU seizes the circuit to which it is connected. |
| MON VOL control/power switch | This is used to control the volume of the audio monitor. The monitor provides means for the user to hear dial tone and test progress tones (TPTs). TT and MF outpulsing may also be heard. DP outpulsing is not audible however.<br><br>The power switch is also incorporated into the monitor volume control. At the extreme counterclockwise position of this control, ac power is switched off. An associated POWER indicator (green LED) illuminates when the unit is on. |
| MODE rotary switch | This four-position rotary switch is used to select the DP, TT, MF, or TEST mode. The first three modes are used to select the type of signaling necessary for the particular trunk under test (TUT). One of these three modes must be used when outpulsing the access number. |

**TABLE D (Cont)**

**CONTROLS AND INDICATORS**

| CONTROL OR INDICATOR | DESCRIPTION |
|---|---|
| MODE rotary switch (Cont) | After the TUT has completed to the far-end test line or responder, the TEST mode is used during all test procedures. |
| LOOP START/ GROUND START toggle switch | In the LOOP START position, when the MRU goes off hook a loop current path is established. In GROUND START position, when the MRU goes off hook it applies ground to the ring lead of the TUT. After a one-half second delay, the MRU enables the loop current path and releases the ring ground. |
| SEND momentary pushbutton | Pressing this button initiates outpulsing of test code or access number information shown on the Model 3558 MRU display field. For test codes 41-46, 52 and 57, the unit is set up internally for measurement. |
| POWER green LED | Illuminates to indicate that power is applied to the unit. |
| KEYPAD 12-button keypad | The keypad is used to enter access numbers and test codes.<br><br>The asterisk (*) key functions as a character erase key to delete a character after it has been entered.<br><br>With Touch Tone (TT)® signaling, the pound (#) key is indicated by a "P" on the display. |
| CLEAR momentary pushbutton | This button is used to erase the display field register selected by the MODE switch. Information stored in the unselected display memories remains unaffected. The CLEAR button may be depressed to terminate outpulsing during a pause. |
| PAUSE momentary pushbutton | During entry of data into either DP, TT, or MF memory, this button is used to insert a pause in a sequence of digits being outpulsed. A pause is indicated by a dash (-) on the display. Pressing the SEND button causes outpulsing to resume after a pause. |
| MEAS/SCK momentary pushbutton | The pushbutton alternately selects the SELF-CHECK mode and the MEASURE mode.<br><br>The SELF-CHECK mode verifies the internal calibration of the MRU and the far-end responder, and the MEASURE mode performs the indicated test on the TUT. |
| ANSWER red LED | Illuminates when wink or ground start answer supervision is received from the far-end equipment. |
| CURSOR toggle | This two-position spring return toggle controls the position of the flashing cursor on the display. When the switch is momentarily moved either to the left or right, the cursor steps one digit in that direction. If the switch is held in position for approximately one second, the cursor steps repetitively until it reaches either end position. |

### C. Circuit Connections

**2.07** Circuit connections are made to a 310-type jack or to the two five-way binding posts mounted on the front panel. (See Figure 1.)

### D. Power

**2.08** The MRU is powered from a 115-V ac source. The power switch is incorporated into the MON VOL control located on the front panel. A green POWER lamp illuminates when the power is on. (See Figure 1.) A protective 2 amp, AGC fuse receptacle is located on the rear panel. A removable six-foot, three-conductor power cord (Belden-type 17745, or equivalent) is plugged into the rear panel connector. Figure 2 shows the location of the fuse and the power cord connection on the rear panel.

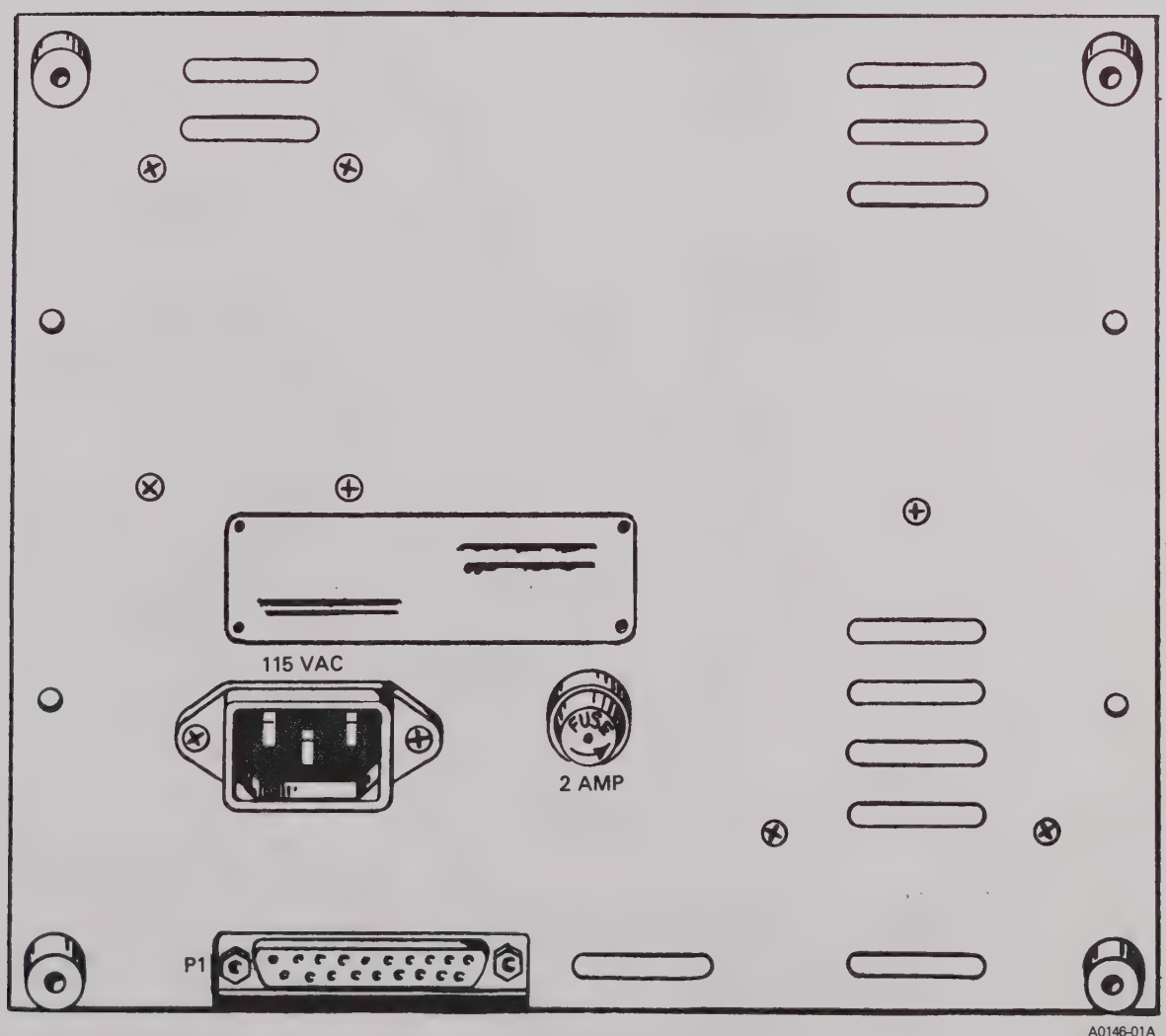


**Fig. 2—Back Panel**

## E. Options

### 2.09 Printer Interface

**2.10** The Model 3558 MRU can be optionally configured to connect to a customer-supplied printer via an RS-232C interface. Table E shows the EIA and FSK model numbers. The MRU uses a 30-cps (300 baud) character rate and ASCII format. A character is made up of a start bit (always "0" or space), seven data bits (least significant bit first), a parity bit, and one stop bit (always "1" or mark). Figure 3 illustrates the character serial data bit timing.

**2.11** The 25-pin RS-232C connector (P1) is mounted on the Model 3558 MRU back panel. The pin callouts for the printer interface are described in Table F. Figure 2 shows the location of P1 on the back panel.

**2.12** Figure 4 shows a sample printout from the MRU using a Texas Instruments Silent 700 Printer.

### 2.13 Carrying Case

**2.14** A fiberglass carrying case with preformed foam liner is available for carrying the MRU and necessary accessories.

### 2.15 Rack Mounting

**2.16** Mounting ears to install the MRU in a standard 19- or 23-inch equipment rack are also available.

**TABLE E**

**MODEL NUMBERS**

| | |
|---|---|
| Non-EIA MRU | Model 3558A-1 |
| EIA MRU | Model 3558A-2 |

**TABLE F**

**RS-232C CONNECTOR PIN CALLOUTS**

| PIN NUMBER | CIRCUIT | DESCRIPTION |
|---|---|---|
| 1 | AA | Protective ground |
| 2 | BA | Receive data |
| 3 | BB | Transmit data |
| 4 | CA | Request to send |
| 5 | CB | Clear to send |
| 6 | CC | Data set ready |
| 7 | AB | Signal ground (common return) |
| 8 | CF | Carrier detect |
| 20 | CD | Data terminal ready |

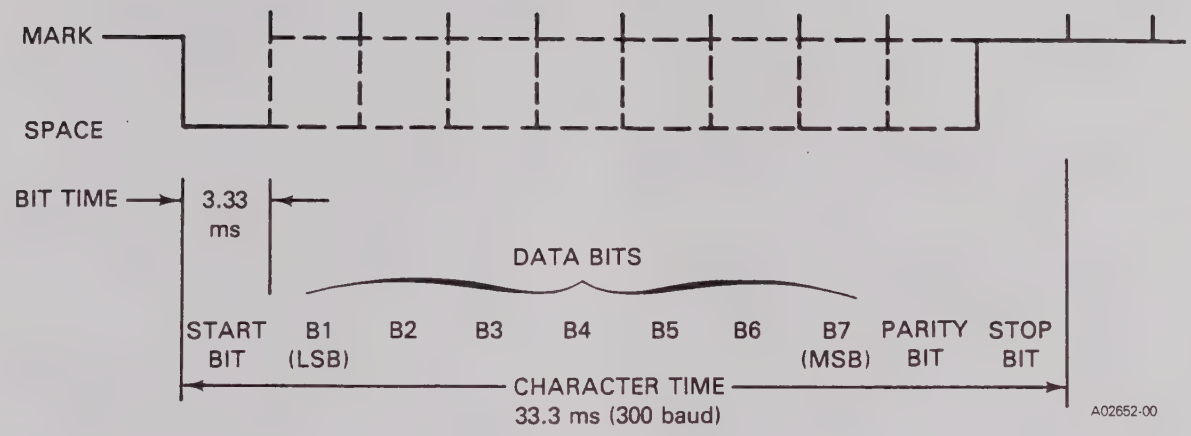


**Fig. 3—Serial Data Timing Diagram**

```
NORTHEAST ELECTRONICS
  MODEL 3558 MRU

OFF HOOK

FAR END NUMBER  5730037

LOSS MEASURE  (DBM)
        F-N                 N-F
       - 8.9               - 8.5

IDLE NOISE MEASURE  (DBRNC)
        F-N                 N-F
        18                  20

GAIN SLOPE 404HZ MEASURE  (DBM)
        F-N                 N-F
       -25.9               -25.1

GAIN SLOPE 1004HZ MEASURE  (DBM)
        F-N                 N-F
       -24.6               -24.0

GAIN SLOPE 2804HZ MEASURE  (DBM)
        F-N                 N-F
       -31.2               -30.4

NOISE/TONE MEASURE  (DBRNC)
        F-N                 N-F
         39                  34

TERMINAL BALANCE ERL MEASURE  (DB)
        F-N                 N-F
                            10

TERMINAL BALANCE SRL MEASURE  (DB)
        F-N                 N-F
                            13

TERMINAL BALANCE SRH  MEASURE  (DB)
        F-N                 N-F
                             5

ON HOOK                                  A02652-01A
```

**Fig. 4—Sample Printout Using Texas Instruments Silent 700 Printer**

## 3. OPERATION

### A. Start-up Procedure

**3.01** Start the Model 3558 MRU as follows:

(1) Connect the power cord to a 120-V ac power source.

***Caution: Do not defeat the third-wire ground. Failure to heed this warning may result in equipment damage and shock hazard.***

(2) Put the unit in the ON HOOK position using the OFF HOOK/ON HOOK toggle switch on the unit's front panel.

(3) Apply power to the unit by turning the MON VOL control clockwise from the OFF position. The POWER indicator (a green LED) will illuminate, and the word "PASS" will appear for about five seconds in the display on the front panel.

***Note:*** If the POWER indicator fails to illuminate, check the power cord for proper connection and check to see if the fuse has blown. If the POWER indicator illuminates and the word "PASS" fails to appear in the front panel display, the internal program is not working and the unit needs service. (See Part 5.)

(4) Select loop start or ground start operation using the LOOP START/GROUND START switch.

(5) Connect the unit to the circuit to be tested using the jacks or binding posts found on the front panel of the unit.

**3.02** If the MRU is to be connected to a printer for recording of test and self-check results, use a 25-pin plug to connect the printer to the unit. Figure 2 shows the location of the 25-pin connector (P1) on the back panel and Table F shows the RS-232C connector pin callouts.

***Caution: Make sure that the printer interface uses the same pin callouts as the MRU. Failure to perform this check may result in equipment damage or malfunction.***

### B. Far-End Access and Test Initiation

**3.03** Access the far-end 105 test line and responder by performing the following steps:

(1) Enter the far-end number as follows:

(a) Using the MODE rotary switch, select the proper signaling mode: DP for dial pulse, TT for Touch Tone (TT)® , or MF for multifrequency (CCITT #5 compatible).

(b) Enter the access number (15 digits maximum) using the 12-button keypad and the PAUSE pushbutton. Note that a pause is indicated by a dash (-) on the display and that a pound sign (#) is indicated by a "P" on the display. Note that the KP and ST command for MF are automatically entered.

(c) Make sure that the access number is correct and edit it if necessary as follows:

(i) Using the CURSOR toggle switch, position the cursor to the right of the character to be changed.

(ii) Enter the correct character. The cursor will advance to the next character.

(iii) Or press the asterisk (*) key to erase the character.

(2) Enter the test codes as follows:

(a) Select the TEST mode using the MODE switch. (When the TEST mode is selected, the labels F → N and N → F will be illuminated in the center and at the right of the display, respectively.)

(b) Enter the proper impedance code for the TUT in display position one using the keypad: "6" for 600-ohm or "9" for 900-ohm terminations.

(c) Enter the proper TLP code in display position two using the keypad: "0" for 0 dBm or "2" for − 2 dBm TLP.

(d) Use the MEAS/SCK pushbutton to select the desired code: measure "≡", or self-check "□". This code is displayed in the third display position.

(e) Enter the desired two-digit test code in display positions four and five. The two-digit test codes are shown on the front panel of the MRU and in Tables G and H.

***Example:*** The following display shows test codes for a 900-ohm circuit impedance, 0 dBm TLP, and measuring for loss (at 1004 Hz).

(f) Make sure that the test code is correct and edit it if necessary as follows:

(i) Using the CURSOR toggle switch, position the cursor to the right of the character to be changed.

(ii) Enter the correct character. The cursor will advance to the next character.

(iii) Or press the asterisk (*) key to erase the character.

(3) Transmit the stored far-end access code and test code as follows:

(a) Put the unit off hook using the OFF HOOK/ON HOOK switch on the front panel. If the TUT is equipped for answer supervision, the ANSWER light will illuminate when answer is received.

(b) Select the proper signaling mode (DP, TT, or MF) using the MODE switch.

(c) Press the SEND button to outpulse the stored digits. If there are any pauses in the outpulsing sequence (to accommodate access via Centrex, PBX, etc.), depress the SEND button to resume the outpulsing sequence, or depress the CLEAR button to terminate the outpulsing sequence.

***Note:*** When the digits have been outpulsed, the far-end test line sends one of two audible responses: a 2225-Hz test progress tone (TPT) indicating that the far-end test line is connected, or a 60-IPM tone indicating that the test line is busy. When the TPT is received, the MRU is connected and testing may proceed.

(d) Select the TEST mode using the MODE switch.

(e) Press the SEND button to transmit the test commands.

**3.04** When the SEND button is depressed, one of two series of events occur:

- The test commands are transmitted as evidenced by a series of MF tone pairs heard through the MRU audio monitor. After the test commands are sent, a measurement signal and data are received by the MRU and presented in the appropriate areas on the display field.

- Or, the word "Error" appears on the display. This indicates that the test code is incorrect. Edit the test code as shown in the previous procedure and retransmit the test commands using the SEND button.

## C. Additional Testing

**3.05** After a test command is transmitted, the cursor remains at the second test code digit (character 5). This facilitates keypad entry to modify the second digit of the test code for other tests. This feature may be bypassed by selecting the test ALL code (see Table G). The test ALL code is used to sequentially perform the loss, noise, gain slope, and noise with tone tests, or test codes 01-06 inclusive. The MRU steps to the next test in the sequence automatically.

**3.06** The MRU repeats the current test command automatically at approximately 14-second intervals. This prevents the far end from timing out. The automatic repetition of the test commands can be terminated by depressing the CLEAR button, sending another test command, or by switching the MODE switch out of the TEST position.

**3.07** Enter the test codes and continue the testing as follows:

(1) Use the MEAS/SCK pushbutton to select the desired code: measure "Ξ", or self-check "□". This code is displayed in the third display position.

(2) Enter the desired two-digit test code in display positions four and five. The two-digit test codes are shown on the front panel of the MRU and in Tables G and H.

***Example:*** The following display shows tone generating codes for a 600-0hm termination, – 2 dBm TLP, gain slope measurement for far-end at 404 Hz.

62≡53.....

(3) Make sure that the test code is correct and edit it if necessary as follows:

(a) Using the CURSOR toggle switch, position the cursor to the right of the character to be changed.

(b) Enter the correct character. The cursor will advance to the next character.

(c) Or press the asterisk (*) key to erase the character.

(4) Press the SEND button to transmit the appropriate test commands.

### D. Test Codes

**3.08** There are two classes of far-end equipment with which the MRU can communicate. The first comprises test lines and responders. The associated test codes are shown in Table G. The second class is made up of measuring instruments such as transmission test sets, ERL test sets, and other Model 3558 MRUs that use terminations and tones provided by the MRU. The test codes for this class of instrument are shown in Table H. The test codes for both classes of far-end equipment are also shown on the front panel of the MRU.

**TABLE G**

**TEST CODES**

| RESPONDERS AND TEST LINES | MODE | LOSS | NOISE | GS 0.4 | GS 1.0 | GS 2.8 | N/T | ALL | ERL | SRL | SRH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 105-type | TEST/SCK | 01 | 02 | 03 | 04 | 05 | 06 | 10 | 07 | 08 | 09 |
| NED 3558 | RECEIVE | 41 | 42 | 43 | 44 | 45 | 46 | — | — | — | — |
| | TRANSMIT | 51 | 52 | 53 | 54 | 55 | 56 | — | 57 | — | — |
| 107-type | RECEIVE | 41 | 42 | 43 | 44 | 45 | 46 | — | — | — | — |
| 100-, 102-type | RECEIVE | 41 | 42 | — | — | — | — | — | — | — | — |
| 104-type | RECEIVE | 41 | 42 | — | — | — | — | — | — | — | — |
| | TRANSMIT | 51 | — | — | — | — | — | — | — | — | — |

**TABLE H**

**TERMINATION AND TONE TEST CODES**

| TERMINATION OR TONE | TEST CODE |
|---|---|
| 1004 Hz, 0 dBm0 (loss) | 51 |
| Quiet Termination (noise) | 52 |
| 404 Hz, – 16 dBm0 (gain slope) | 53 |
| 1004 Hz, – 16 dBm0 (gain slope) | 54 |
| 2804 Hz, – 16 dBm0 (gain slope) | 55 |
| 1004 Hz, – 16 dBm0 (C-notch) | 56 |
| Quiet Termination (ERL) | 57 |

## E. Data Output

### 3.09 Data Display

**3.10** The display areas for far-to-near and the near-to-far are under the illuminated "F → N" and "N → F" labels on the display filter. In the case of two-way measurements, both the far-to-near and the near-to-far results appear on the display. When one-way measurements are made, the results appear beneath the appropriate label.

### 3.11 Negative Results

**3.12** The results of measurements which have a negative value are displayed with a minus sign preceding the value. Positive values are displayed without a sign.

### 3.13 Measured Data Beyond Limits

**3.14** Measured data is displayed as just described unless it exceeds the range limits normally associated with the measurement. An "H" (for high) or an "L" (for low) is displayed in the appropriate location to designate which limit has been exceeded. Table I shows the range limits programmed into the MRU.

### 3.15 Self-Check Output

**3.16** In addition to the measurement tests, a set of self-check test instructions is included to permit the user to verify the calibration of internal and responder measuring devices. When these test codes are used, the display will indicate any deviation error in the responder measuring circuits. Self-check measurements that are out of the acceptable range are displayed as flashing digits.

**TABLE I**

**DATA RANGE LIMITS**

| MEASUREMENT | TEST CODE | LOW LIMIT | HIGH LIMIT | |
|---|---|---|---|---|
| Loss (1004 Hz, 0 dBm0) | 01,41 | – 15.7 dBm | + 1.9 dBm | ± 1 count |
| Noise (quiet termination) | 02,42 | 16 dBrnC | 54 dBrnC | ± 1 count |
| Gain slope (404 Hz, – 16 dBm0) | 03,43 | – 36.7 dBm | – 14.1 dBm | ± 1 count |
| Gain slope (1004 Hz, – 16 dBm0) | 04,44 | – 36.7 dBm | – 14.1 dBm | ± 1 count |
| Gain slope (2804 Hz, – 16 dBm0) | 05,45 | – 36.7 dBm | – 14.1 dBm | ± 1 count |
| C-notch (1004 Hz, – 16 dBm0) | 06,46 | 35 dBrnC | 73 dBrnC | ± 1 count |
| ERL (quiet termination) | 07 | 40 dB | 0 dB | |
| SRL (quiet termination) | 08 | 40 dB | 0 dB | |
| SRH (quiet termination) | 09 | 40 dB | 0 dB | |

## 4. TESTING

### A. General

**4.01** Telephone trunks must be tested for three major reasons:

- To ensure a new trunk meets all circuit order test requirements before it is placed into service
- Routine tests must be made at regular intervals to ensure the trunk still meets all required limits.
- To locate and correct troubles on defective trunks.

**4.02** The Model 3558 MRU is ideal for performing most of these types of tests.

**4.03** Trunk signaling tests should always be performed before any transmission tests are made because the trunk must be properly conditioned by the signaling pulses if accurate transmission test results are to be obtained. As an example, most trunk relay circuits provide an idle circuit termination (ICT) across the tip and ring when the trunk is idle. Upon seizure the idle circuit termination is lifted off. If the termination is still on when a transmission test is made the result will be in error.

**4.04** Loss measurements should always be made first. If the loss is not within limits, other tests, such as C-message noise, will not be accurate because they will be offset by the error in the loss measurement.

### B. Access Points

**4.05** Access to any trunk for testing purposes using the Model 3558 MRU must be made at a two-wire point having either a 600- or 900-ohm impedance and a known test level. If the impedance or test level is unknown at the point of access, meaningful results will not be obtained from the transmission tests.

**4.06** Trunks are accessed for testing by three distinct methods:

- Wire jumper access
- Direct jack access
- Switched access.

**4.07** The jumper access method is the most difficult since it involves disconnecting and reconnecting frame jumper wires. Extreme caution must be used to avoid interrupting other services. Common jumper wire access points are:

- Main Distributing Frame (MDF)
- Intermediate Distributing Frame (IDF)
- Cable Terminals
- Connecting Blocks.

**4.08** Direct jack access is the most common method of trunk access and is usually associated with the older electromechanical switching systems design. Test access is usually easiest at a testboard, test position, or switchboard since individual jacks are provided for each trunk. These locations provide:

- Jack access to the trunk for transmission, operational, and signaling tests
- Control of the trunk state, i.e., in-service or busied out.

Common direct jack access points are:

(a) Testboard

(b) Test Position

(c) Switchboard

(d) Patch Bays (e.g., carrier system or trunk circuit)

(e) Central office equipment jack fields

(f) Trunk relay circuit test jack.

**4.09** Switched access is used with the more modern control or stored program switching systems. In this method the switching machine is directed to access and seize a particular trunk by keying in the required trunk address instructions at a central test panel. Once accessed and seized the trunk is then available for testing at a jack located on the test panel. Examples of these switched access systems are:

- Bell System Test Frames
- Bell System SMAS
- TTI SAS
- ADC RAS

## C. Transmission Levels

**4.10** The test tone levels used for testing trunks depend on the test method employed and the type of trunk. The following levels have been standardized:

- For manual testing of voice frequency trunks a level of 0 dBm0 is used.
- For manual testing of voice frequency data circuits a level of – 13 dBm0 is used.
- For Bell System SARTS or CAROT systems a level of 0 dBm0 or – 16 dBm0 is used.
- For international trunks – 10 dBm0 is used.

These levels are all referenced to 0 dBm0 and are offset by the transmission level point (TLP) at the trunk test access point.

**4.11** Standard transmission level points (TLP) have been established for the following offices:

- Digital end office 0 TLP
- Analog end office 0 TLP
- Digital toll office – 3 TLP
- Analog toll office – 2 TLP

**4.12** Standard transmission level points (TLP) have also been established for the following carrier systems:

| | Receive TLP | Transmit TLP |
|---|---|---|
| • Analog carrier systems | – 16 | + 7 |
| • D1 channel bank | – 9.25 | + 2.75 |
| • D2 channel bank | – 16 | + 7 |
| • D3 channel bank | – 7.5 | + 2.5 |
| • D4 channel bank | – 8.5 | + 4 |

## D. Transmission Test Lines

**4.13** Transmission test lines are used for trunk transmission maintenance. They are accessed by outpulsing on the trunk under test (TUT), toward the far-end office, the appropriate code or number required. The code or number varies depending on the type of office and the kind of trunk as follows:

- At a toll office a 3-digit 10X code is used on intertoll trunks. (X is any digit from 0 to 9).
- At a toll office a 3-digit NNX code is used on toll connecting trunks.
- At an end office a 7-digit subscriber number is used.

When testing toward an end office dial a subscriber type number. When testing toward a toll office dial a 3-, 4-, or 7-digit number. Figure 5 shows both toll connecting and intertoll trunks on an intercity type of connection.

### 4.14 Balance (100 Type) Test Line

**4.15** The code 100 or balance type of test line is used for making office balance and noise tests. Figure 6 shows the testing arrangement.

**4.16** The balance test line provides a quiet termination consisting of a 600- or 900-ohm resistor in series with a 2.16 MFD capacitor. It also provides off-hook supervision to the calling party as long as the connection is held.

**4.17** Newer versions of the 100 type test line provide a 1004-Hz tone at 0 dBm0 upon seizure for approximately 5 seconds followed by a quiet termination. These test lines enable one-way loss, noise and balance measurements to be made.

### 4.18 Milliwatt (102 Type) Test Line

**4.19** The code 102 or milliwatt type of test line is used for one-way loss measurements. Figure 7 shows the testing arrangement.

**4.20** The milliwatt test line provides a 9-second, 1004-Hz tone interval at 0 dBm0 upon seizure, and also off-hook supervision to the calling party during this interval. This is followed by on-hook supervision with an idle circuit termination (ICT) and no tone until released.

**4.21** Some early versions of the 102 type test line provided nine seconds of tone with off-hook supervision followed by one second of no tone with on-hook supervision in a continuous cycle until released.

### 4.22 Transmission Measuring and Noise Checking (104 Type) Test Line

**4.23** This type of test line is used for two-way loss measurements and one-way noise checking. Figure 8 shows the testing arrangement.

**4.24** The test line provides off-hook supervision. It measures the 1004-Hz loss of the TUT in the near to far (N → F) direction. This measurement is made when a 1004-Hz priming tone is applied to the TUT for 5 to 10 seconds at the near-end. The test line then applies a 1004-Hz tone to the TUT for a near-end loss measurement. After a timed interval the level of the tone is reduced by the amount of loss measured in the near to far (N → F) direction. A wink signal is transmitted to the near-end if this loss is more than 10 dB. After a timed interval, tone is removed and a noise check is made at the far-end. If the noise exceeds a preset limit a flashing supervisory signal is returned to the near-end.

### 4.25 Automatic Transmission Measuring (105 Type) Test Line

**4.26** This type of test line is used for automatic two-way loss and noise measurements by using a near-end Remote Office Test Line (ROTL) and a far-end responder. A responder is always associated with the ROTL in the near-end office and the 105 test line in the far-end office. Figure 9 shows the testing arrangement.

**4.27** This type of test line provides access to a far-end responder. Up to 15 test lines may be associated with a common responder. The test lines act as parking circuits for test calls queued up awaiting connection to the responder.

**4.28** Off-hook supervision is returned to the near-end upon seizure along with a 2225-Hz test progress tone (TPT). If the responder is idle the TPT is removed and the test line is connected to the responder.

**4.29** Newer vintage responders provide for additional tests such as:

- Three frequency gain slope measurements at 404 Hz, 1004 Hz, and 2804 Hz at – 16 dBm0
- Noise with tone (N/T) or C-notch noise
- Peak to average ratio (PAR) measurements
- Echo return loss (ERL)
- Singing point low and high (SRL AND SRH).

**4.30** The responder is not readily adaptable to manual tests unless the near-end office is equipped with a compatible unit such as the Model 3558 MRU.

**4.31** The near-end ROTL/responder is directed by a CAROT or similar type controller for automatic testing. For manual testing a compatible ROTL control unit such as the Northeast Electronics Model 3555 ROTL Access Unit may be used.

### 4.32 Data Transmission (107 Type) Test Line

**4.33** This type of test line is used for one-way testing of data and voice transmission parameters. Figure 10 shows the testing arrangement.

**4.34** Upon seizure the test line provides the following sequence of events:

| | | |
|---|---|---|
| 0.2 Second | Off-Hook | Quiet Termination |
| 15 Seconds | On-Hook | PAR Signal |
| 1 Second | Off-Hook | Quiet Termination |
| 10 Seconds | On-Hook | 1004-Hz Tone – 16 dBm0 |
| 1 Second | Off-Hook | Quiet Termination |
| 10 Seconds | On-Hook | 404-Hz Tone – 16 dBm0 |
| 1 Second | Off-Hook | Quiet Termination |
| 10 Seconds | On-Hook | 2804-Hz Tone – 16 dBm0 |
| 20 Seconds | Off-Hook | Quiet Termination |
| 17 Minutes | On-Hook | 1004-Hz – 16 dBm0 |
| 1 Second | Off-Hook | Quiet Termination |
| 17 Minutes | On-Hook | 1004-Hz – 16 dBm0 |

Repeats until released

## E. Responders

**4.35** As indicated in paragraph 1.04 the Model 3558 MRU is capable of performing cooperative two-way testing with many different responders.

**4.36** The primary function of a responder is to make automatic transmission measurements on telephone trunks upon command from a central location. Figure 11 shows the testing arrangement.

**4.37** There are several different automatic transmission measuring systems in service today, a few being:

- Northeast Electronics COMPUTRACE System
- Automation Products RAMPART System
- Western Electric CAROT System

**4.38** Responders are used in conjunction with 105 type test lines at far-end offices. The test lines interface a responder to the central office switching equipment. They provide the proper dc conditions, answer supervision, holding, release, termination, etc. required to answer test calls and cut them through to the responder. They also return a 2225-Hz test progress tone (TPT) when seized. When the call is cut through to the responder the TPT is removed.

**4.39** Multiple test lines (15 maximum) may be used with a single responder to handle various types of trunks. The trunks may have different supervision, impedance (600 or 900 ohms) and transmission level point (TLP 0 or – 2) pad requirements. When more than one test line is used the test lines act as parking circuits and calls are handled in the order received.

**4.40** Responders are also used at near-end offices in conjunction with Remote Office Test Lines (ROTLs). In centralized automatic transmission measuring systems ROTLs in remote offices are accessed over the DDD network. After seizure the ROTL is instructed to select a trunk for testing (TUT) to the far-end office. Multifrequency (MF) commands then tell the responders to execute the required transmission measurements. The measurement results are then transmitted by the ROTL to the central location over the DDD access connection.

**4.41** Near-end offices equipped with an ROTL are also known as remote offices because they are remote from the central location. Figure 11 illustrates this.

**4.42** Measurement results are transmitted to the central location by means of frequency shift keying (FSK). A guard tone interval of 1200 Hz is followed by a burst of 2200-Hz data tone followed by a 1200-Hz guard tone interval. The guard tone intervals are of a set duration. The length of the 2200-Hz data tone burst is proportional to the measurement result. The duration of the data tone burst is directly related to the loss in dB, noise in dBrnC or other measurement result.

**4.43** ROTLs may be interrogated by the:

- Bell System ATMS Director
- Bell System CAROT Controller
- Bell System PCI in No. 1 ESS
- Bell System ROTL System Test Set
- Northeast Electronics COMPUTRACE System
- Northeast Electronics Model 3555 ROTL Access Unit
- Automation Products RAMPART System
- Automation Products Model 1061 TOTL Test Set

**4.44** Responders are capable of performing a self-check of their own circuitry for each type of test they are capable of performing.

**4.45** Responders are addressed by means of multifrequency (MF) commands. The commands are sent in sets or layers.

**4.46** The MF signaling system uses the following six frequencies:

| | |
|---|---|
| 700 Hz | 1300 Hz |
| 900 Hz | 1500 Hz |
| 1100 Hz | 1700 Hz |

**4.47** MF digits or commands are represented by simultaneously sending 2 of the 6 (2/6) frequencies. Table J shows the MF signaling system.

## TABLE J

## MF SIGNALING SYSTEM

| DIGIT NO. | MF FREQ HZ | DESCRIPTION | |
|---|---|---|---|
| 1 | 700+900 | Numerical Digit | 1 |
| 2 | 700+1100 | | 2 |
| 3 | 900+1100 | | 3 |
| 4 | 700+1300 | | 4 |
| 5 | 900+1300 | | 5 |
| 6 | 1100+1300 | | 6 |
| 7 | 700+1500 | | 7 |
| 8 | 900+1500 | | 8 |
| 9 | 1100+1500 | | 9 |
| 10 | 1300+1500 | | 10 |
| 11 | 700+1700 | Inward Operator | CCITT |
| 12 | 900+1700 | Delay Operator | Signaling |
| KP1 | 1100+1700 | Terminal Call | System |
| KP2 | 1300+1700 | Transit Call | No. 5 |
| ST | 1500+1700 | End of pulsing sequence | |

**4.48** Table K shows the responder test and self-check codes used by the Model 3558 MRU in interrogating a responder.

**TABLE K**

**RESPONDER TEST AND SELF-CHECK CODES**

| TEST CODE | MF SIGNAL (Hz) | TEST DESCRIPTION |
|---|---|---|
| 01 | 700+1100 | Loss measure 1004 Hz 0 dBm0 |
| 02 | 900+1100 | Noise measure (C-message) |
| 03 | 1100+1300 | Gain slope loss 404 Hz – 16 dBm0 |
| 04 | 900+1700 | Gain slope loss 1004 Hz – 16 dBm0 |
| 05 | 1300+1700 | Gain slope loss 2804 Hz – 16 dBm0 |
| 06 | 1500+1700 | Noise with tone measure (N/T) |
| 10 | All of above | Test codes 01-06 sent in sequence |
| 07 | 700+1700 | Echo return loss measure (ERL) |
| 08 | 900+1500 | Singing return loss LOW (SRL) |
| 09 | 700+1100 | Singing return loss HIGH (SRH) |
| | | All of the test codes are preceded by the ☰ measure symbol on the display in position 3. |
| 01 | 700+900 | Loss self-check |
| 02 | 700+1300 | Noise self-check |
| 03 | 1100+1300 | Gain slope 404 Hz self-check |
| 04 | 900+1700 | Gain slope 1004 Hz self-check |
| 05 | 1300+1700 | Gain slope 2804 Hz self-check |
| 06 | 1500+1700 | Noise with tone self-check |
| 10 | All of above | Self-check codes 01-06 sent in sequence |
| 07 | 700+1700 | Echo return loss self-check |
| 08 | 900+1500 | Singing return loss LOW self-check |
| 09 | 700+900 | Singing return loss HIGH self-check |
| | | All of the self-check codes are preceded by the ☐ self-check symbol on the display in position 3. |

## F. Testing Methods

### 4.49 Precautions

**4.50** To ensure accurate test results the following precautions must be observed:

***Caution: Do not defeat the third-wire ground on the Model 3558 MRU ac power cord. Failure to heed this warning may result in equipment damage and electrical shock hazard.***

*Note:* The Ground Start signaling function may also be inoperative.

(1) Access to the TUT must be made at a point having the following characteristics:

(a) Two-wire location

(b) 600- or 900-ohm impedance

(c) 0 or – 2 TLP.

(2) Verify the TUT is idle before proceeding with any testing.

(3) The TUT must be properly conditioned by signaling and in the correct "state."

(4) Verify the far-end test number is correct.

(5) Make loss measurements first. If loss is out of limits, other test results will be offset by the error in the loss measurement.

### 4.51 Test Codes

**4.52** The proper test codes to be used are determined by the type of test line or test set being accessed at the far-end, and the type of test being performed as follows:

- TABLE K -Responder Test and Self-Check Codes
- TABLE L - Receive Test Codes
- TABLE M - Transmit Test Codes

**4.53** The tables show the function performed by each test code.

**TABLE L**

**RECEIVE TEST CODES**

| TEST CODE | TEST DESCRIPTION |
|---|---|
| 41 | Receives a 1004-Hz 0 dBm0 tone from the TUT for a near-end loss measurement |
| 42 | Receives noise from the TUT for a near-end noise measurement |
| 43 | Receives a 404-Hz – 16 dBm0 tone from the TUT for a near-end gain slope measurement |
| 44 | Receives a 1004-Hz – 16 dBm0 tone from the TUT for a near-end gain slope measurement |
| 45 | Receives a 2804-Hz – 16 dBm0 tone from the TUT for a near-end gain slope measurement |
| 46 | Receives noise with a 1004-Hz – 16 dBm0 tone from the TUT for a near-end N/T measurement |

**TABLE M**

**TRANSMIT TEST CODES**

| TEST CODE | TEST DESCRIPTION |
|---|---|
| 51 | Sends a 1004-Hz 0 dBm0 tone to the TUT for a far-end loss measurement |
| 52 | Applies a quiet termination to the TUT for a far-end noise measurement |
| 53 | Sends a 404-Hz – 16 dBm0 tone to the TUT for a far-end gain slope measurement |
| 54 | Sends a 1004-Hz – 16 dBm0 tone to the TUT for a far-end gain slope measurement |
| 55 | Receives a 2804-Hz – 16 dBm0 tone to the TUT for a far-end gain slope measurement |
| 56 | Sends a 1004-Hz – 16 dBm0 tone to the TUT for a far-end N/T measurement |
| 57 | Applies a quiet termination to the TUT for a far-end balance measurement such as echo return (ERL) or singing point (SRL or SRH) |

### 4.54 PBX - CO Trunk Tests

**4.55** All dial PBX and Automatic Call Distributor (ACD) trunks use loop signaling equipped with ground start supervision. Because of this it may be necessary to reverse the tip and ring leads for proper operation when testing on these types of trunks. Figure 12 shows the testing arrangement for testing from the PBX to the serving central office on the TUT.

**4.56** In the more modern PBXs such as Bell System Dimension, provisions have been made for switched access to select trunks for testing. Reference should be made to appropriate Bell System or Northeast Electronics practices for detailed trunk access information and testing procedures.

**4.57** Many PBXs today are equipped with various types of test lines. Where this is the case, tests may be made from the serving central office to the PBX on the TUT. The positions of the test line and MRU 3558 shown in Figure 12 would then be reversed.

### 4.58 PBX Tie Trunk Tests

**4.59** A PBX tie trunk connects two PBXs together for inter-PBX type calls. The PBXs may be in the same city or in different cities. Figure 13 shows the testing arrangement.

### 4.60 Subscriber Loop Tests

**4.61** Go/no-Go or comparative type loss and noise measurements may be made on subscriber loops. Figure 14 shows the testing arrangement.

**4.62** It is important to note that these measurements are ***not*** accurate as to absolute value. The displayed test result will blink on test codes 41 and 42 to help alert the user to this fact. This is because the subscriber loop impedance at the connecting block is not exactly 600 or 900 ohms. Also the TLP will vary from 0 TLP for a very short loop to – 10 TLP for a very long loop. Useful comparative indications may still be obtained however.

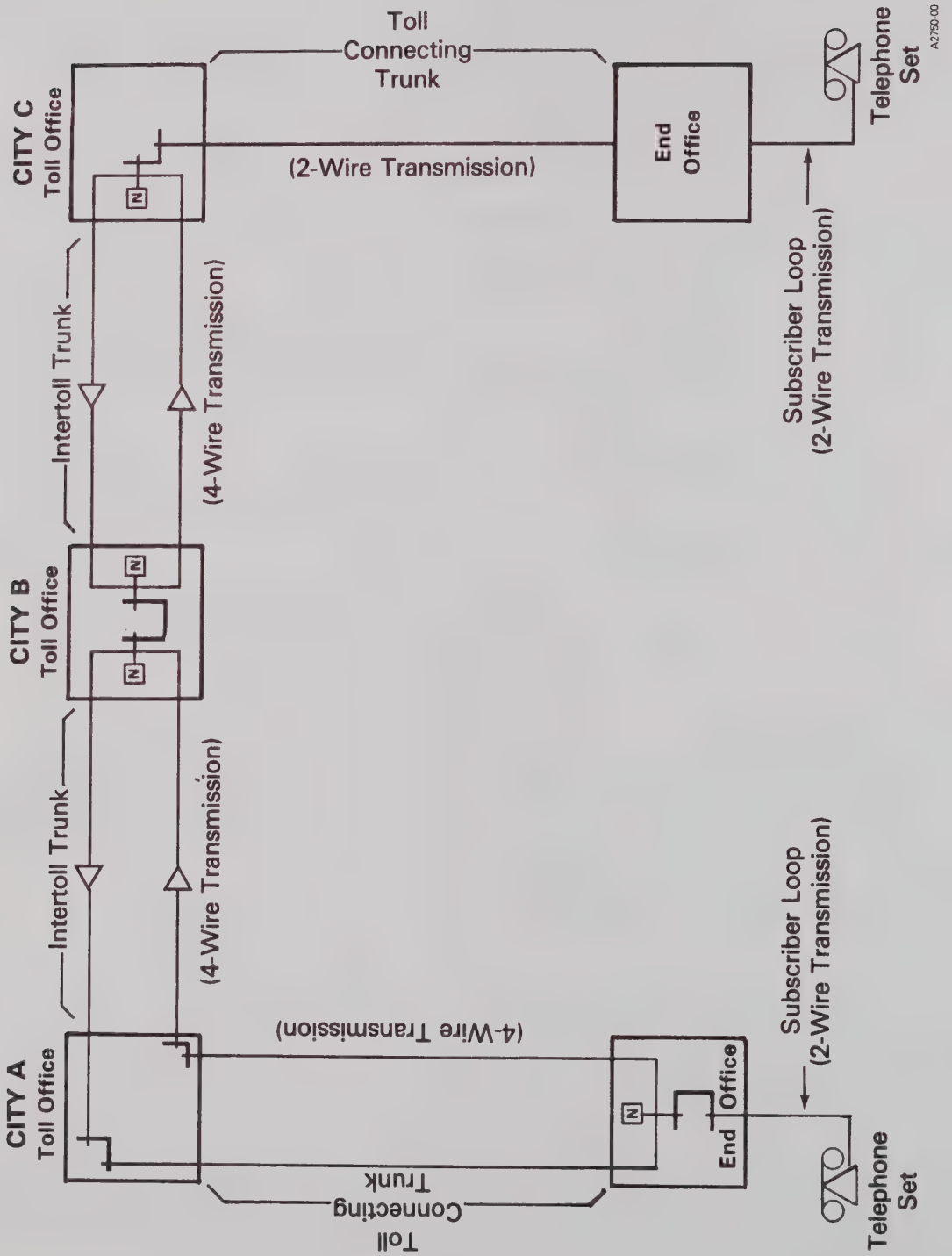


**Fig. 5—Intercity Subscriber to Subscriber Connection**

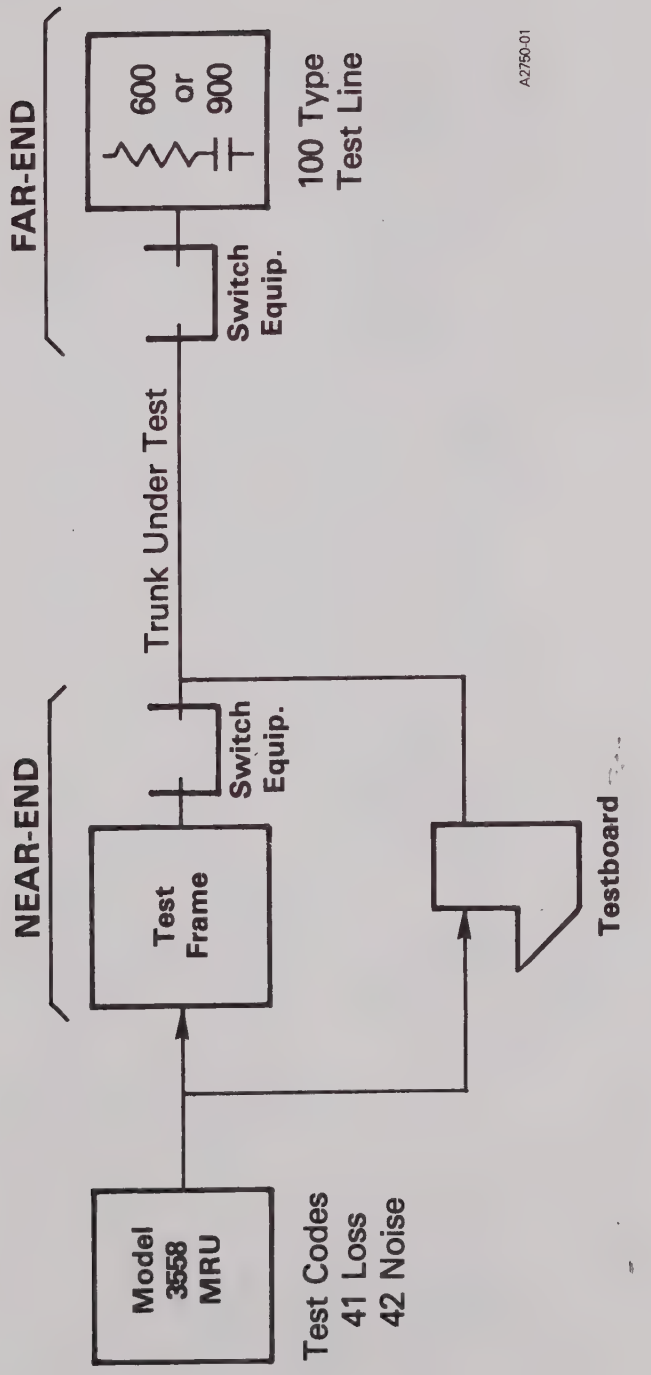


Fig. 6—Balance (100 Type) Test Line Testing Arrangement

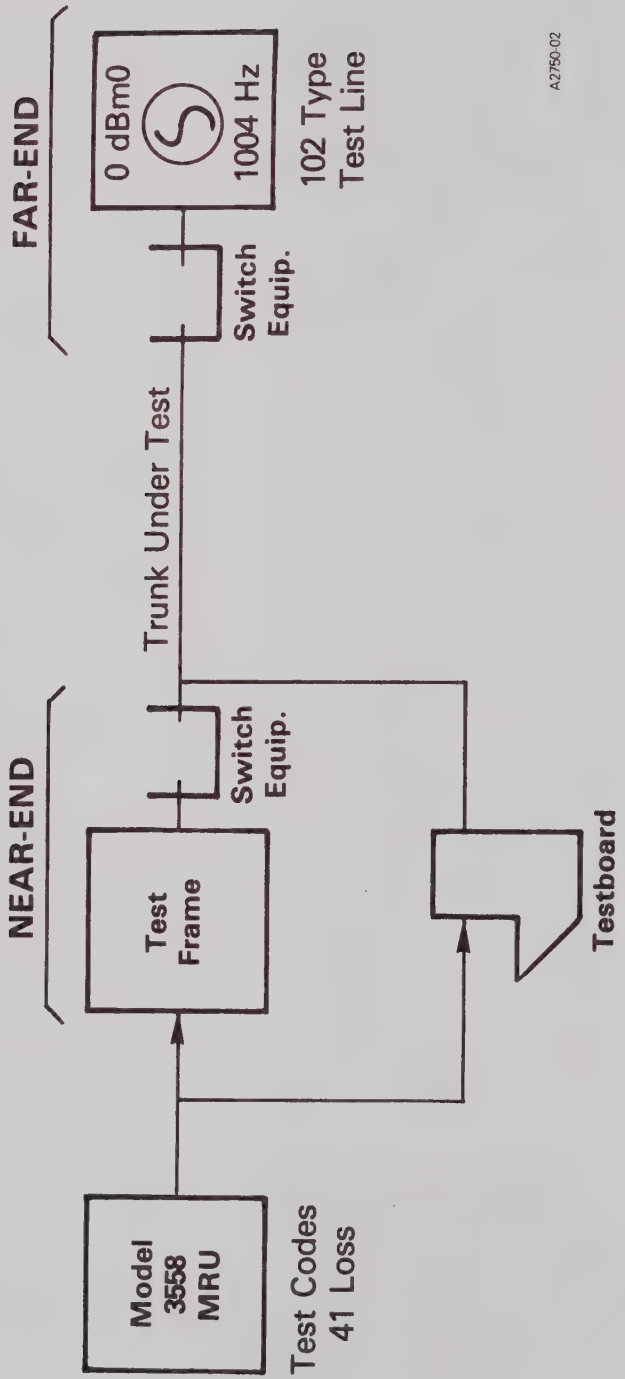


**Fig. 7—Milliwatt (102 Type) Test Line Testing Arrangement**

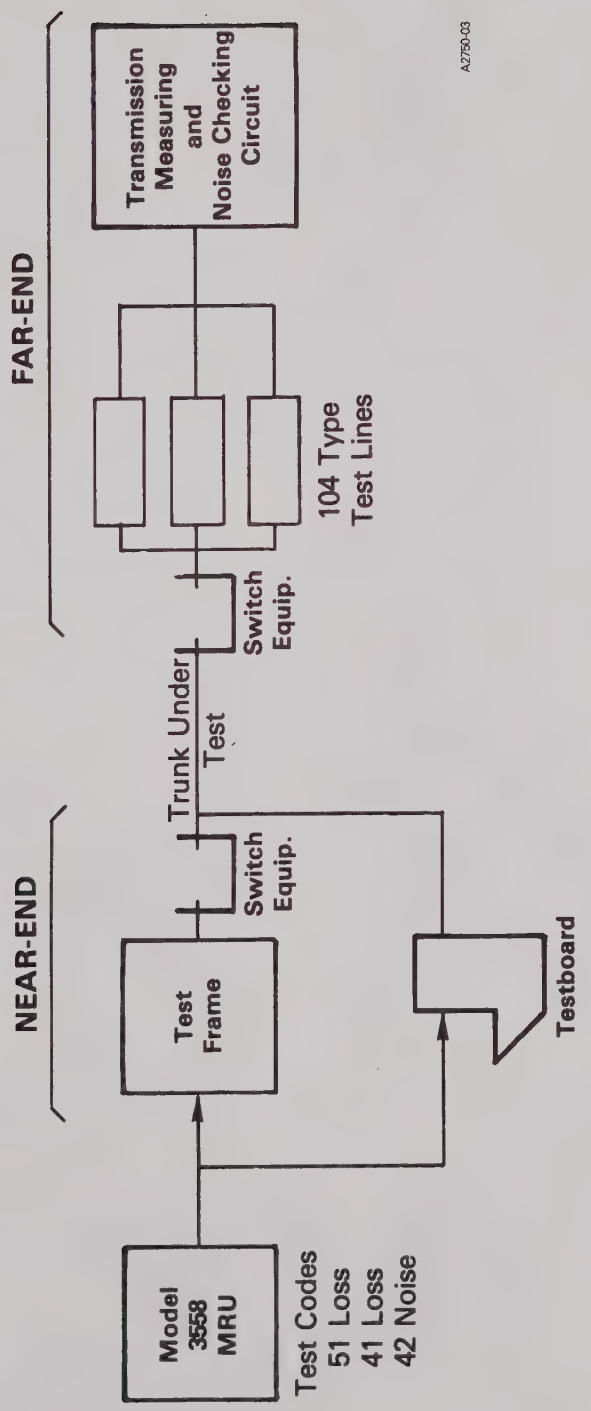


**Fig. 8—Transmission Measuring and Noise Checking (104 Type) Test Line Testing Arrangement**

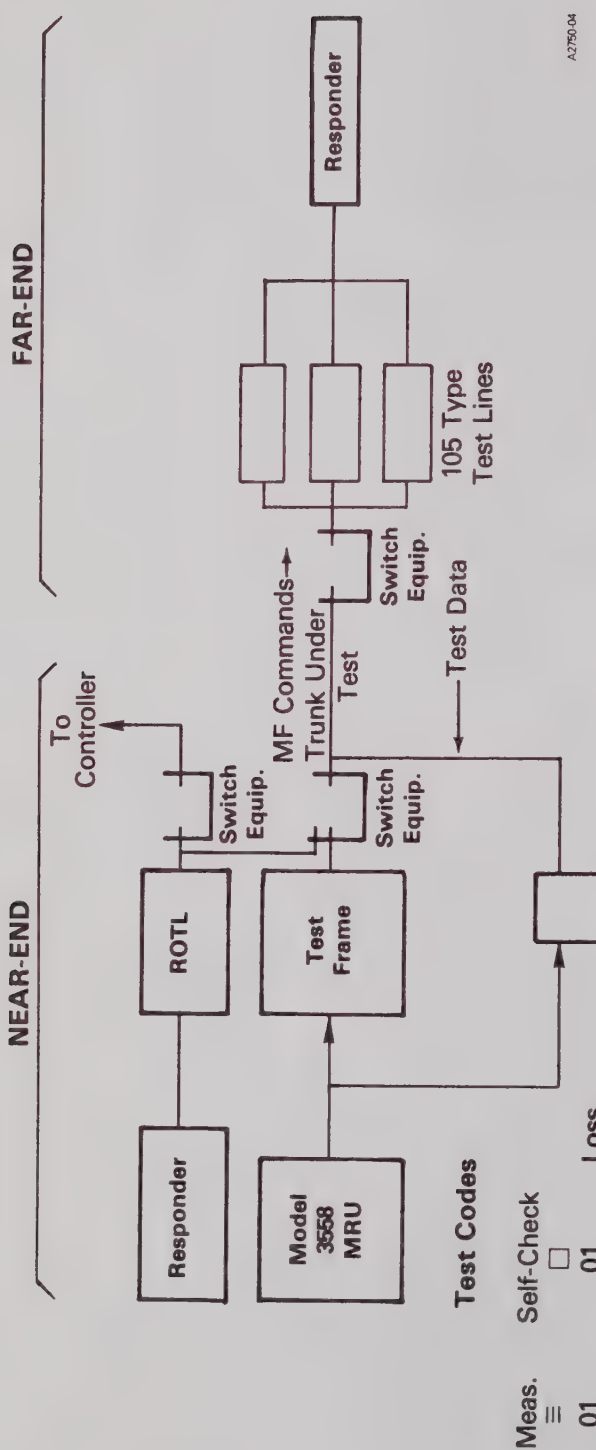


**Fig. 9—Automatic Transmission Measuring (105 Type) Test Line Testing Arrangement**

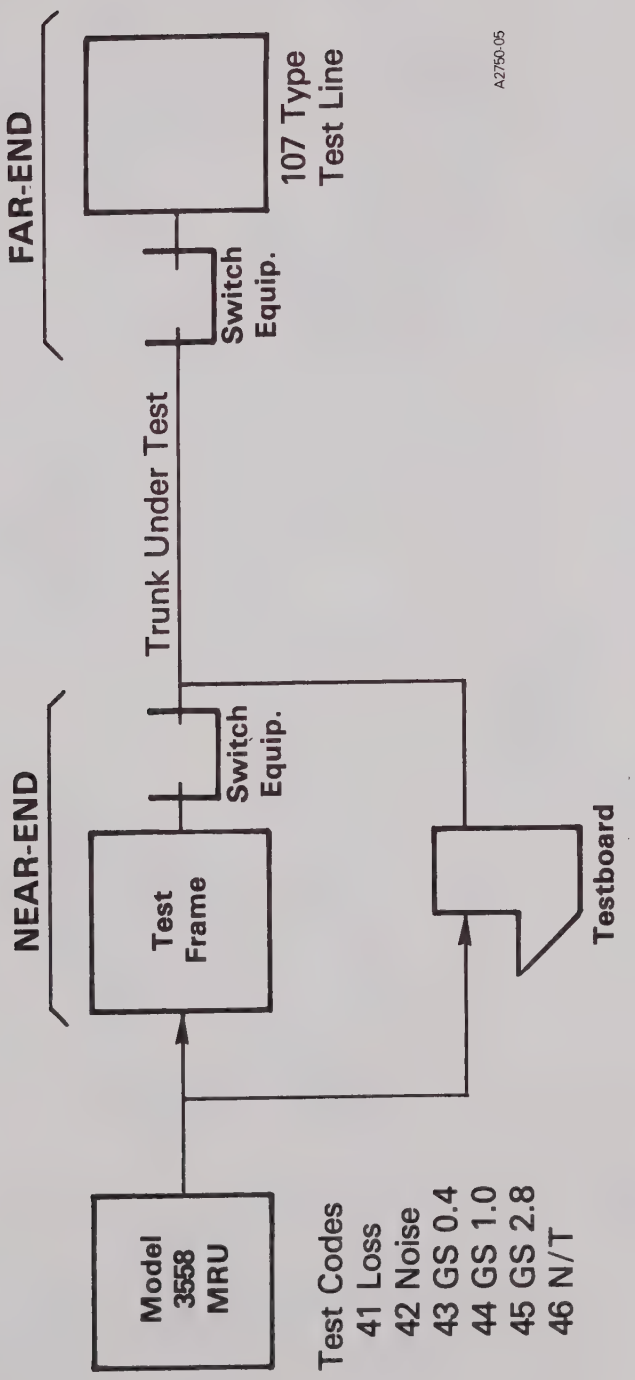


**Fig. 10—Data Transmission (107 Type) Test Line Testing Arrangement**

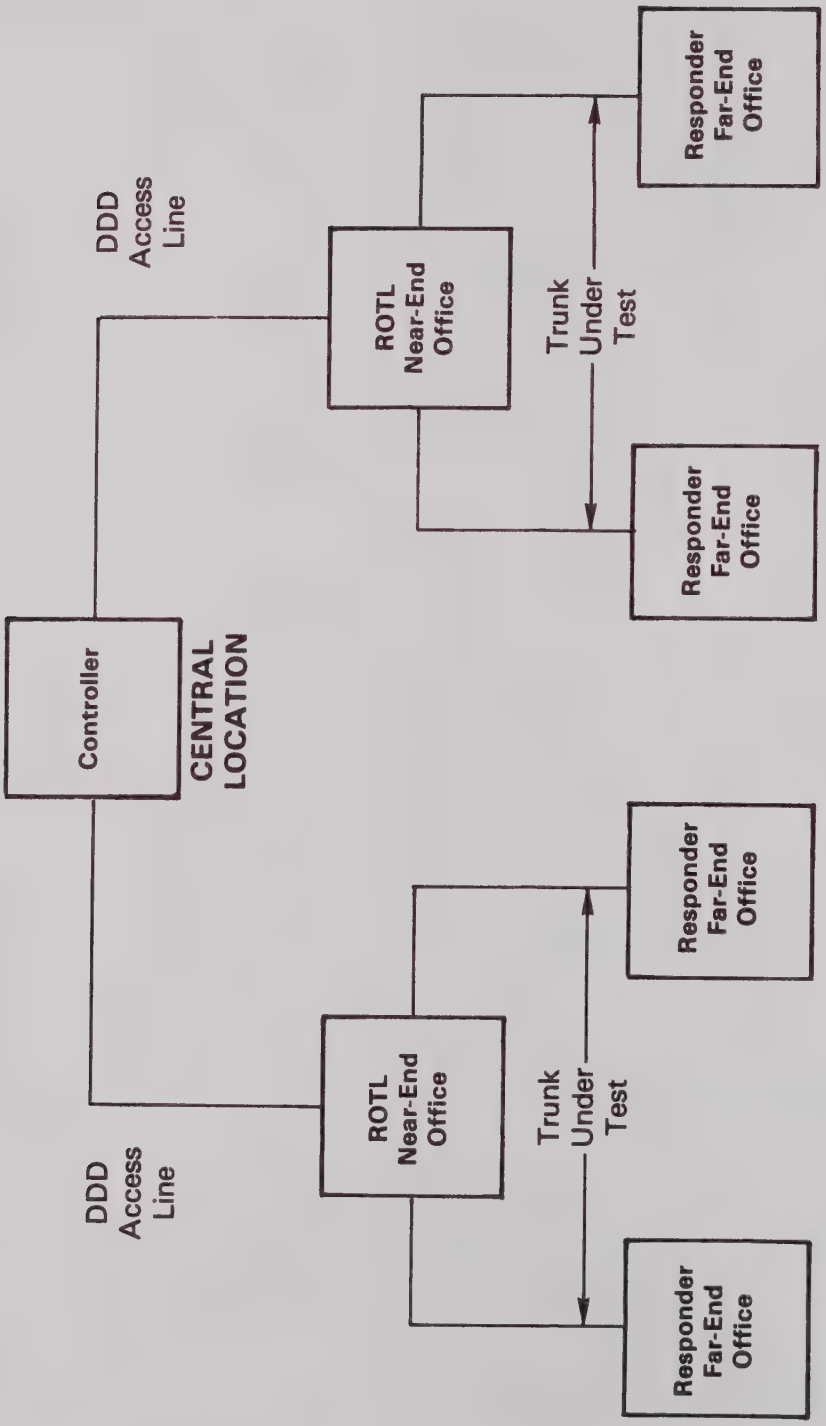


**Fig. 11—Automatic Transmission Measuring System Test Arrangement**

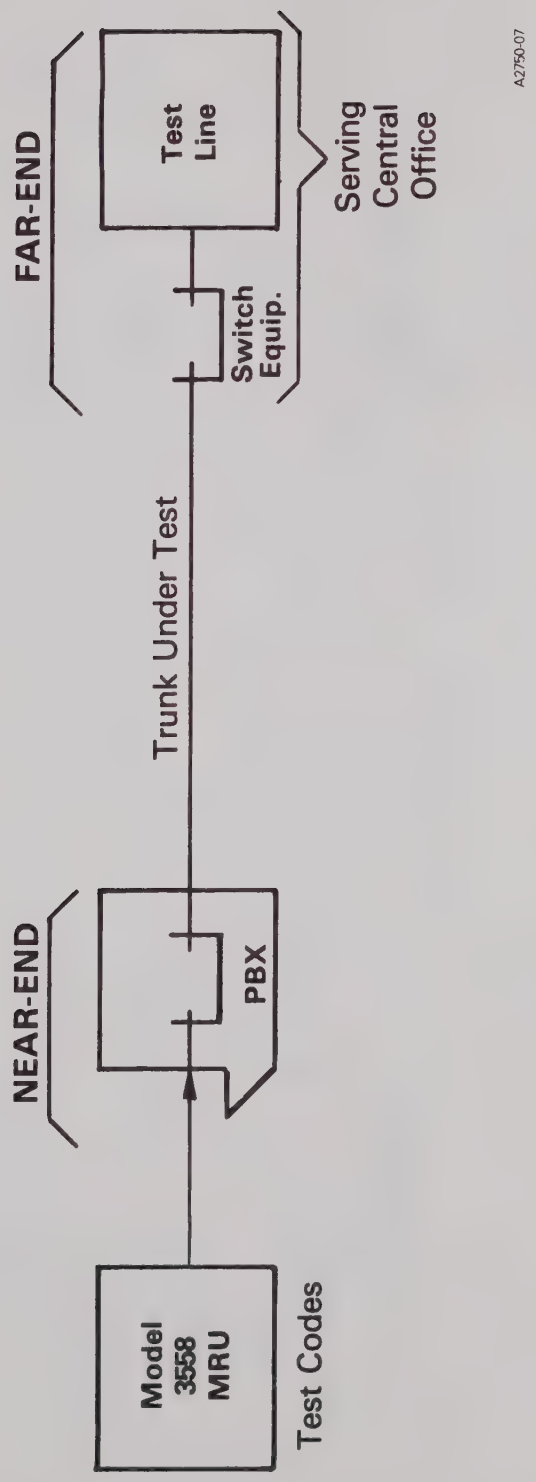


Fig. 12—PBX - CO Trunk Tests

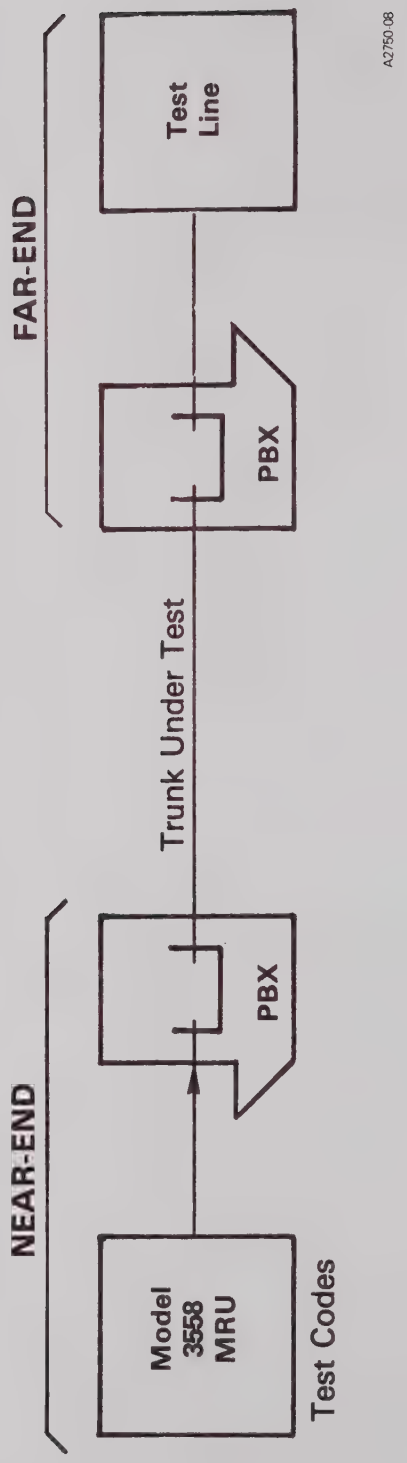


**Fig. 13—PBX Tie Trunk Tests**

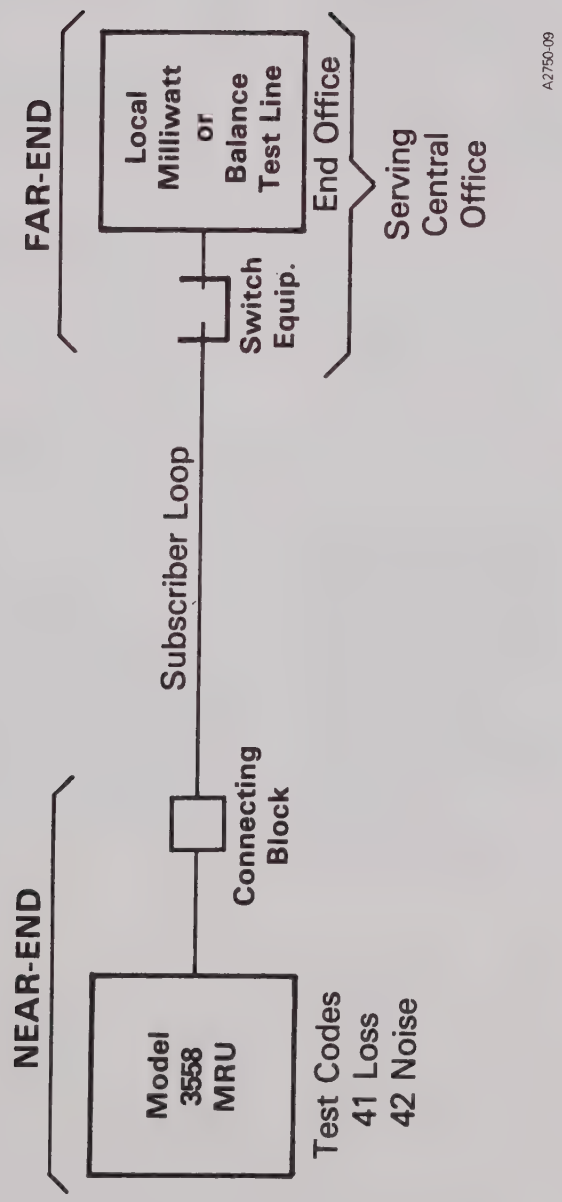


Fig. 14—Subscriber Loop Tests

# 5. MAINTENANCE

## A. General

**5.01** The Model 3558 MRU uses microprocessor control for all its functions. All signaling frequencies, timing intervals, and display decoding are precisely controlled by a common crystal time base. No field calibration is recommended for the unit.

**5.02** Field repairs of the MRU are not recommended. For technical assistance, contact the Repair Department at Northeast Electronics at (603) 228-3700.

## B. Initial Inspection

**5.03** The signaling display is carefully inspected, both mechanically and electrically before shipment. It should be working properly when received. If damage from transit is found, notify the transportation carrier immediately.

## C. Service Information

**5.04** Complete warranty information is contained in the purchase order agreement under terms and conditions of sale. Summarized briefly, the Northeast Electronics warranty extends for a period of one year to the original purchaser of a Northeast test instrument. Northeast's system products are covered by a special warranty which can be summarized as follows:

- ☐ Hardware items are warranted for a period of 90 days.
- ☐ Software is warranted for a period of one year.

**5.05** It is recommended that Northeast's Repair Department be contacted for assistance if, for any reason, a Northeast product fails to perform as expected. This step eliminates the needless delay entailed when a product is returned unnecessarily. Contact the Repair Department at Northeast Electronics, P.O. Box 2021, Concord, New Hampshire 03301; telephone: (603) 228-3700.

**5.06** If a Northeast Electronics product requires factory servicing ***during*** the warranty period, be sure to include a ship-to address and a description of the problem when returning the product to Northeast Electronics.

***After*** the warranty period has expired, equipment returned must be accompanied by all of the following:

- ☐ The number of the purchase order covering the cost of servicing,
- ☐ Bill-to address,
- ☐ Ship-to address, and
- ☐ Description of problem.

**5.07** In all cases, Northeast Electronics products should be returned directly to our Factory Service Center in Concord, New Hampshire for repair. Any material requiring repair must be returned to Northeast via a Return Material Authorization (RMA) Number, which will be assigned by the Service Center Order Processing Administrator. Customers may call the Factory Service Center at (603) 228-3700 for the assignment of the number.

***Warning:** This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.*

422-1502
489-1209
483-8116
1-971-1205

northeast electronics
DIVISION OF tau-tron inc.
A UNIT OF GENERAL SIGNAL

57 Regional Drive P.O. Box 2021 Concord, N.H. 03301
1-603-228-3700 1-800-222-4124 (Outside N.H.)

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